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METHODOLOGY IN PHYSICS AND PSYCHOLOGY WITH PHILOSOPHIC IMPLICATIONS

Part II

IN PART I[1] a methodology for physics was developed along the Lunn-Ostwald-Gibbs insight into the actual course of modern research. The obvious interpretation of this methodology contrasts sharply with the traditional views regarding secondary qualities, and it leads to a view of the physical world quite at variance with the contemporary view as expressed in Eddington's *Nature of the Physical World,* in which physical reality is reduced to schedules of pointer readings. We shall now describe briefly the sharp contrast between these two views, then let Galileo make two statements of his postulation regarding secondary qualities and develop these postulations to their consequences. We shall then seek escape from the absurdities of these consequences by adopting the obvious interpretation of the methodology set forth in Part I.

With these ideas in mind it becomes pertinent first to inquire about the present striking contrast between the world as the modern physicist sees it, and the same world as viewed by common sense. Eddington, in the *Nature of the Physical World,* gives a very clear and entertaining view of this contrast, in a man undertaking to walk through a door. The board upon which he steps is moving at the rate of twenty miles per second around the sun. A mistake of a small fraction of a second and he will miss the board by many miles. He is hanging by his toes to a spherical ball with his head projecting into space with no meaning to any question about up and down. The board has no solidity. In fact it is made of molecules which roughly resemble a swarm of flies. He may fall through it. In fact, although Eddington does not mention this, he could jump through it without any injury to either himself or the board if he would only jump fast enough. For his body is nothing but another swarm of flies. The flies are so very minute, and relatively to their size so far apart, that the swarm constituting his body and that other constituting the board could pass the one through the other without any chance that more than an infinitesimally small part of the flies would collide and hurt one another. If he starts to fall through this swarm of flies, a fly will hit him and drive him back. If he falls

[1] In preceding issue, No. 4.

again, another will hit him. If one should hit him too hard and drive him to the ceiling or if he should fall through, it would be no violation of nature's law, but only a remarkable coincidence. However, he hopes that between these remote possibilities he will keep his fairly even way, Eddington goes on to say. And finally, in order to determine whether this passage through the door is an exit, or an entrance, the direction in which the world's entropy is changing will have to be laboriously determined. And Eddington goes on to say, verily it is easier for the camel to pass through the eye of a needle than for a scientific man to pass an ordinary doorway.

Arthur J. Balfour in his British Association presidential address in 1904 stated what he believed to be an unsolved paradox. He said, "It may seem singular that down to, say, five years ago, our race has, without exception, lived and died in a world of illusions, and that its illusions or those with which we are here alone concerned, have not been about things remote or abstract, things transcendental or divine, but about what men see and handle, about those plain matters of fact among which common sense daily moves with its most confident step and most self satisfied smile." Strange that the world should have been emancipated from complete illusion by some physicists between 1899–1904!!!!

"It [the electric theory] analyzes matter, whether molar or molecular, into something that is not matter at all . . . while the monads themselves are not regarded as units of matter, but as units of electricity, so that matter is not merely explained but explained away."

"Now the point to which I wish to direct attention is not to be sought in the great divergence between matter as thus conceived by the physicist and matter as the ordinary man supposes himself to know it, between matter as it is perceived and as it really is, but to the fact that the first of these two quite inconsistent views is wholly based on the second." Strange that these wonderful physicists had found matter as it really is in those magic five years preceding Balfour's address.

We claim to found all our scientific opinions on experience; and the experience on which we found our theories of the physical universe is our sense perception of the universe. That is experience. . . . Yet the conclusions which thus profess to be entirely founded upon experience are to all appearance fundamentally opposed to it. The physicist's idea of the world and the common-sense view of it are as different as Eddington's description makes them out.

The relation of the one view wholly inconsistent with the other, yet founded upon it, constitutes a paradox certainly.

In working out a foundation for scientific methodology by rescuing the great insights of men of genius from the obscuration that

the strifes of schools have engendered about them, we shall resolve Balfour's paradox inevitably, for it was nothing but the distortion of Galileo's notable insight that created the paradoxical relation existing today between the common-sense and the scientific view of the world.

There were certain scientific postulations made by Galileo in the very infancy of modern science. He used these words (Burtt's *Metaphysical Foundations of Physics,* page 75), "But first I want to propose some examination of that which we call heat, whose generally accepted notion comes very far from the truth if my serious doubts be correct, inasmuch as it is supposed to be a true accident, affection and quality really residing in the thing which we perceive to be heated. Nevertheless I say, that indeed I feel myself impelled by the necessity, as soon as I conceive a piece of matter or corporeal substance, of conceiving that in its own nature it is bounded and figured in such and such a figure, that in relation to others it is large or small, that it is in this or that place, in this or that time, that it is in motion or remains at rest, that it touches or does not touch another body, that it is single, few, or many, in short by no imagination can a body be separated from such conditions; but that it must be white or red, bitter or sweet, sounding or mute, or a pleasant or unpleasant odour, I do not perceive my mind forced to acknowledge it necessarily accompanied by such conditions. So if the senses were not the escorts, perhaps the reason or the imagination by itself would never have arrived at them. Hence I think that these tastes, odours, colours, etc., on the side of the object in which they seem to exist, are nothing else than mere names, but hold their residence in the sensitive body; so that if the animal were removed, every such quality would be abolished and annihilated."

In these words Galileo expresses a distinction that has been of tremendous service to science. He distinguished from the secondary qualities of matter those primary qualities with which science was to be concerned. Science on the physical side has paid little heed to those secondary qualities of matter which Galileo relegated to the limbo of subjectivity. And physical science has achieved its great success by confining its attention to those aspects of reality which it could measure. But Galileo's way of viewing matters carried within it the sources of future trouble. His reasoning achieved his purpose, but it can not be regarded as impeccable. He held that a body must have the properties of extension in order to be real. But a piece of matter need not be sweet or bitter, yellow or blue. But certainly a piece of matter *must* be sweet or bitter, yellow or blue. It must have some sensuous properties. Without such qualitative sensuous distinctions of some sort there would be no physical bodies. There would be, without these sensuous qualities, nothing but a qualityless

empty space. It is this curious idea of Galileo's that has led physicists to believe in a real substance, the so-called luminiferous ether that might have density, elasticity, and extension, without a single quality that the senses could perceive. It also made possible the belief in such a structure as the Bohr atom as a real existing thing. Galileo's conception of real matter without a trace of sensuous content has ended in the "shadows," the "schedules of pointer readings," the bare abstractions of mathematical physics under the summary of modern physical research made in Eddington's *Nature of the Physical World.*

But we need not on this account underrate the importance of the postulations that Galileo expressed in the quotation given. Burtt speaks fittingly of him in these words (*The Metaphysical Foundations of Physics,* page 95): "Who laid the foundations of the most stupendous intellectual conquest of modern times, the mathematical science of physical nature; and then, as if these accomplishments were not enough, we must turn to him likewise as the philosopher who sufficiently perceived the larger implications of his postulates and methods to present in outline a new metaphysics—a mathematical interpretation of the universe. The natural world was portrayed as a vast, self-contained mathematical machine, consisting of motions of matter in space and time, and man with his purposes, feeling and secondary qualities was shoved apart as an unimportant spectator and semi-real effect of the great mathematical drama outside. In every single respect of importance he broke the ground or otherwise prepared the way for the only two minds in this advancing current of thought comparable to his own—Descartes and Sir Isaac Newton."

Galileo made the postulations which have made it possible for science to do its work. Physical science has made its great progress in modern times by means of measurement. Galileo's assumptions in the passage quoted have enabled the physicist to concentrate his attention upon those aspects of the world that readily lend themselves to the technique of measurement.

But the outcome of three centuries of scientific development may well raise the suspicion that Galileo made his postulations in too radical a manner. Eddington's *Nature of the Physical World* may profitably be regarded as carrying the excesses of Galileo's postulations to their logical terminus of a *reductio ad absurdum.* But the absurdity does not seem to impress Eddington. If it did one would think he would go back and question the premises on which modern science and modern philosophy have both been logically built. But Eddington does nothing of the kind. Hume carried Locke's premises to their logical conclusion without doing the obvious thing—viz., on the strength of the absurdity of these conclusions go back and revise the premises of Locke with which he started. Edding-

ton, like Hume, stops with the absurd conclusions deducible from the premises in which a vast system of thought has been constructed. Such is the striking contrast between the world of common sense and the world of the physicist. This situation has been brought about by the effort to avoid the recognition of the fact that in the case of some physical measurements we are measuring the secondary qualities of bodies. And this effort is inspired by the notion that secondary qualities are not physical but psychical.

Now let us see some of the false quests and some of the confusions into which the effort has led us.

A train of senseless physical waves are travelling in a senseless ether as their medium of transmission. Of course, the contemporary physicist has almost ceased to talk about the ether. But its character is so much like that of the atom which he has not ceased to talk about, that we may be allowed to use it as freely as we use the atom. These senseless waves impinge on the sense organs of a living sentient organism. This living organism is itself a "physical object" of the same senseless character as the ether and its waves. The eye, the retina, the nerve fibers, the brain itself, are composed of atoms that are colorless, tasteless, soundless, touchless, and in every conceivable way senseless. The color and other sense qualities of *my* brain are all in *your* mind, not in my brain, according to the current and the traditional view coming directly out of Galileo's postulations.

Now light falls upon the eye. This means, in "physical" terms, that colorless waves strike these colorless physical objects, the atoms of retina, nerve, and brain, and presto!! Color comes. A world of color comes as effect of the collision of colorless entities and simply and purely by miracle. In that view the whole scientific ideal of explaining the happenings of nature ignominiously breaks down. Science as the dispeller of superstition and obscurantism registers failure. It means that a scientific system of explaining the world can be maintained only by treating all sensation, color, odor, sound, as merely some or other species of nothings. The technical phrase is that these phenomena of sensations are "subjective." At any rate science renounces any responsibility for their explanation. But these "subjectivities" are the very things which human beings care most about. Physical objects are merely the instrumentalities for achieving these all-desired satisfactions of human sensibility. There are these two classes of things in our world, first, the desired end of living, the things that please the sight, the hearing, the touch, and all their innumerable derivatives in the great realm of values, and second, the instrumentalities, the physical objects through which these ends are reached. But end and instrumentality are completely severed in their natures. One can not be expressed in terms of the

other. Yet the one brings the other into existence. The instrumentality appears upon the stage, and then without any rational ground for anticipating it the end comes by miracle.

We may in the end be obliged to give up the age-long cherished ideal of science to banish the miracle from the world. We may have to accept some of Du Bois Reymond's "Ignorabimuses." But neither science nor philosophy has ever taken kindly to the idea. But however we deal with miracle under the modern term of emergence, science is not going readily to give up its ideal of *continuity*. If miracle is to remain it is going to be more generously diffused through the infinitesimal grades of transition from one item of experience to the following one. We are never going to be easily reconciled by any such abrupt transition in natural happenings, although it may be very dramatic, as that of the arrival of sensation, unannounced and unanticipated rationally, as the effect of the bare impingement of senseless "waves" upon the senseless atom of eye and brain. That is too much miracle in one instantaneous step from one phase of experience to the one logically immediately subsequent. The whole process as described in terms of the modern "physical object" is simply highly improbable, as Whitehead puts it. Whitehead's attempt to help this situation has not succeeded very well. Whitehead gives us a kind of Platonic heaven of eternal objects which make "ingressions" into a physical time-space reality —denying the old dogma of simple location. But these non-communicating, independent, and sensuously contentless eternal objects deny the continuity that the scientific ideal expects to find in nature.

Here appears in its utmost irrationality the scientific view of the world based on the common-sense view which it contradicts. Here appears the paradox that Balfour so clearly expressed in 1904.

But we now will look at another very significant breakdown of this same physical view of the world. First, physics tried during the nineteenth century to find in the ether, which had no sensuous properties whatever, all the mechanical properties that belong to other material substances, elasticity, mass, density, etc. This attempt was persistently repeated. Every conceivable theory of the ether was made that could possibly fit the facts and at the same time give the ether the properties of material substances minus the secondary qualities. Every attempt failed. Today physicists have almost ceased to be concerned about the ether. But the atom is making the twentieth-century physicists as much trouble or more than the ether made the nineteenth-century men. The atom has no secondary qualities. It is not that no one ever expects a microscope to be invented powerful enough to see the atom. The atom is defined in such a way that seeing can have no possible meaning in relation to it. Project after project is being made to make a theory for the

atom that will meet the encyclopedic facts to be explained and at the same time make of it an organization that will follow the principles of mechanics. The bankruptcy of this attempt is registered in the giving up of classical mechanics so far as the atom is concerned. The question is, has the atom broken down or has mechanics broken down? Finally relief has come in the Schroedinger atom. The Schroedinger atom has this advantage. It may conceivably have secondary qualities.

In Eddington's view, the physical world, the material world, the *res extensa* has become a world of mere shadows, "Schedules of Pointer Readings." The inner world of human life has become one of mysticism. The history of physics has been showing a drift in this direction for a long time. The ether first faded out in its substantiality to become a mathematical shadow. The Bohr atom has been conceived as a real physical system although it had not a single character that could make it a possible object of sense perception under any conceivable circumstances. But it is proving as impossible to give this atom a consistent character in terms of the primary qualities of matter as it was to find consistency in the conception of a luminiferous ether. At last in the Schroedinger atom something-or-other is undergoing a universal wave motion. This something is called Ψ, psi. This is sometimes interpreted as an electrical charge. An electrical charge is just merely a "something." A unit charge is *something* which placed one centimeter away from another *something* identical with it, except in the matter of spatial location, will repel it with the force of one dyne. The nature of this something is fully defined by this statement. This something means nothing else but what is explicitly stated in those words. The electric charge is a purely mathematical quantity. It has no content except its mathematical relations to other *somethings* which in turn have no content other than their own external relations to still other *somethings*. The world, on these terms, would become a mere complex of somethings, very complexedly related and all their inter-relations would be purely mathematical. Physicists have objected to Einstein's reduction of gravitational mechanics to a mere geometry. These scientists have believed that they were measuring something that is real. It looks as though the time had now come when physicists must give up the physical as such and admit, that while they are really measuring they have not yet found the real things which they are measuring. When it is asked, what are you measuring? the answer is, in Eddington's view, something wholly mystical. The measurements are all they have. If the reality has all oozed out of physical objects, if they are nothing but schedules of pointer readings, the miracle of sense perception would be still more miraculous. In that case when light falls upon the eye from a distant object, the

thing that is happening is that schedules of pointer readings are moving with a velocity of one hundred and eighty-six thousand miles per second and falling upon the atoms of eye, nerve, and brain, which are merely other schedules of pointer readings, and lo and behold, there appears at once a world of color and light and visible form, a grand symphony of impressive nothings freshly created out of nothing.

But a physical object, the atom or the ether, without secondary qualities, can not maintain itself with any other intelligible content. Material objects without secondary qualities appear to have none of the properties of material bodies. The ether has not density, elasticity, or mass, on any assignably intelligible terms. The atom as a mechanical system defies classical mechanics. Here is the second breakdown of the modern physical view.

The two classes of science, the physical and the social, which have developed since Galileo's time, assumed attitudes to each other, hostile, apologetic, conciliatory, indifferent, as circumstances seemed to require. The achievements of the physical sciences when judged by their own standards were overwhelmingly brilliant and impressive. The only attitude which the social sciences could assume in the face of this situation was one of supercilious condescension which acknowledged all that physical science could possibly claim, with the damning postscript that it all concerned the material world and had nothing to do with spiritual interests and man's quest for real knowledge. However, the social scientists were constantly seeking ways of using the methods of physical sciences. Even philosophers like Kant advised philosophy to employ the ways of physics. The one prominent and distinctive feature of physical science and the one which most obviously counted for its success was measurement. Physical scientists themselves considered this feature indispensable for any field of activity that should claim the honorable name of science. Social scientists have made desperate attempts at measurement whenever there was the faintest pretext of being able to measure successfully. Other scientific men working in the field of the inner life, recognizing the futility of measurement, have characterized measurement as the narrowest possible starting point for the definition of a science.

The outcome of these centuries of scientific and philosophic development based on Galileo's postulation is that physical scientists have some measurements of nobody-knows-what, and the social scientists have something which is supremely worth measuring, but which never has been satisfactorily measured. This is the new form for the ancient dualism implied in Eddington's treatment of the matter. I believe Eddington proposes a new dualism between the metrical and the non-metrical portions of experience, in the place

of the traditional dualism of philosophy (*Nature of the Physical World,* page 275). Rather, we should say, the new form of the dualism is between measurements without anything measured and realities unmeasured but demanding measurement.

Having found something which needs measuring, which ought to be measured, but which defies all efforts to measure it, and having found some measurements that measure nothing conceivable on earth below or heaven above, what more natural surmise than this, that the two things so long separated belong one to the other, indissolubly associated.

Galileo treated the secondary qualities of bodies as subjective and as unreal so far as the interest of science was concerned. The outcome of this view of Galileo is that physical nature today is a Pythagorean world of numbers, mere pointer readings, a world which is inconceivable in itself. The lacking element is the whole system of secondary qualities which the physicist uses in his data, but which he discards as he builds up a conceptual science. The absurdity, confusion, and false leads which have been the direct consequences of Galileo's treatment of the secondary qualities have been sufficiently indicated in the preceding pages. We have seen in the study of the electric circuit, following the outlines of the Ostwald-Gibbs insight, that the most obvious way of treating the situation after this *reductio ad absurdum* of the Galilean postulation, is to understand the measured factors of the circuit's activity, its current, voltage, and the duration of action as the three dimensions of heat and color, which are secondary qualities.

We have been struck by the strange coincidence that while the psychologist has had something which is worth measuring and has had very limited success in measuring it, the physicist, believing initially that he had something to measure, has found himself in the end with a vast wealth of measurements on his hands with the slowly dawning sense that they measure nothing.

We are now led to the conviction, from the considerations presented, that the physicist has been all the time measuring at least what the Galilean postulation relegated to the province of psychology, the secondary qualities. The secondary qualities are at least a part of the stuff of which the world is made and the primary qualities are the measurements of the secondary. One step to this conclusion remains to be taken. Einstein's relativity constitutes that step. For space, extension, a primary quality of bodies, is a measurement. Most of the difficulties that the layman has with the Einstein views are overcome when space is recognized as a system of pointer readings. The best preparation for grasping relativity conceptions of space is just such a treatment of physical methodology as was given in the first part of this paper in the study of the electric circuit.

The definitions of geometry are made like the definitions of current and voltage in a way to guide the operation of measuring them. Parallel lines are not defined in terms of what they will do at infinity. Geometrical definitions are given in a way to make the measurement of geometrical quantities possible. After measurements have been made the relations between measurables is sought by empirical and rational methods in geometry and physics alike. So the relations between the sides of a right-angled triangle are worked out with a realization that space is not something in its own independent and self-sufficing existence, but that it is a measurement of something that is not space.

The physicist must measure his stuff with just the same kind of purpose and attitude toward it that the carpenter has when he measures his lumber. He measures what has been called the secondary qualities to the end of building a world with them, not to the end of building an imposing conceptual structure of number and geometry. Neither the physicist nor the mathematician is building up a Platonic or Aristotelian system of universals as an end product. The scientific methodological process is a cycle, that begins with a world taken on its qualitative terms and it returns, after the whole cycle of definition, measurement, correlation, and analysis is completed, to a world where the stuff of reality, the secondary qualities, have been remeasured and proportioned into a new structure. And no doubt the new measurements and the new proportioning of the ancient stuff has given birth to new qualities just as the Parthenon revealed a new beauty in architecture. The schedules of pointer readings, the abstract numbers, are not the whole thing, but they do something to their material.

In the swing from the old world of measured qualities to the new there is no ground for a distinction between matter and mind, or the material and mental. The process is taking place as the essential system of activities of an atomic whole in the course of its evolution and transformation. At no stage does anything appear that can be separated from the whole. All the time the whole is suggesting to the operating human whole, which is coöperating with it, the definitions that are to guide the measurements. At the point where the measurements emerge as abstract numbers there is a trace of independence which if considered superficially might indicate a susceptibility on their part of being separated out from the concrete whole and becoming a universal or at least a concept with all the prerogatives of distinction from the physical that have always been assumed by the so-called mental. But this independence is only relative and it is limited to the bare abstract measurements and to the one function which it serves in its relation to the process by

which the whole is being transformed. Its function is to enable us to come to a knowledge of the whole one step at a time, to know one thing at a time, without the necessity of knowing everything all at once. But we need not use the term "knowledge" in this connection, with its mental implications. This relative independence of each measurable has the function of enabling the atomic whole to undergo its transformation through coöperation with the human organism in the only way that that organism seems able to make preparation for effecting evolutionary change in other wholes, viz., by taking one step at a time.

This independence is undoubted so far as it goes. The current is measured in the electric circuit independently of the measurement of any other measurable such as voltage, and *vice versa*. It is this independence that gives objectivity to the relations of these measured factors of the current's activity. All the dimensions of the circuit, current, voltage, and resistance, have this limited and relative independence in the determination of their measured values in their mere status as abstract numbers. Therefore, the discovered mathematical relations between them are empirical and objective. This relative independence saves these relations from being conceptual circular definitions, each one of them in terms of all the others. Independence of this limited and relative character does not justify an independent and separate logical status for these measured physical dimensions such as the realist's term "universal," or the conceptualist's term "mental concepts" would imply. For these measurables have their meaning in the operations by which they have been defined and measured. For the measurements have been completely controlled by the definition and the whole, as a whole, has suggested the definitions and they have been made in terms of the whole, and each measurable has been defined in terms that relate it through the whole to each of the other measurables. The meaning of the measured factor is implicated most intimately in the structure and activity of the whole. The current is measured through the definition that it is that function of the whole circuit which is everywhere the same along the circuit and adds across the circuit. Complementary to this is the definition that directs the operation of measuring voltage as that function of the whole circuit that is everywhere the same across the circuit and adds along the circuit. The meaning of each measurable is contained in the operation that measures it. But that operation is one that involves the atomic whole to which it belongs acting as a whole in its full concreteness, in its matter constituting secondary qualities, and in its measurements defined in terms of its material and physical concreteness. There is no ground in the very limited independence of the abstract numbers in which the measur-

ing process ends to justify the giving to them, or to what they are supposed to measure, that status which would set them apart either as universals or as constituents of a mental order distinct and separable from the whole with which they have relations so intimate as fairly to characterize that whole as an organic mechanism, to use Whitehead's phrase. We may still have what we call universals, but their intimacy of relationship to the atomic whole is not sufficiently characterized by saying that they are immanent in it. The meaning of the term "immanence" has been acquired when the methodology of science and philosophy was in an earlier stage of evolution than today. The measurements, the abstract Pythagorean numbers, the Eddington schedules of pointer readings, are inseparable from the stuff which they measure, the secondary qualities and their organized character in atomic wholes. There is no dualism of metrical and non-metrical as Eddington holds, but a monism of measured quality, a phrase that fails to represent the fact, in which the distinction of adjective and substantive breaks down.

After the measurables have been defined by the nature of the atomic whole and measured, their empirically discovered relations quickly reveal them as the dimensions of those secondary qualities which were dominant aspects of the whole before the analysis had begun. In other words, the cycle is completed. We have returned to a whole in which the qualitative aspect is strongly in evidence.

Language is involved in the cycle. But words are material symbols which are the psychological and purely behavioristic conditions for stimulating coöperating activity on the part of some human organism in the cyclic processes by which atomic wholes evolve. This methodology makes drastic behaviorism and drastic nominalism possible.

The analyzed elements of the whole which always remain *in situ* are always relative to the whole as it is at the given stage of the evolution. They have no absolute character. Therefore when new problems raise a challenge to a new process of evolution of an atomic whole, and the whole must be acted upon by the coöperating human organism, it is as though analysis had never left any marks upon it. The researches that have been the most significant are those in which some highly gifted scientific man has approached his problem as a man of mere common sense might be imagined to approach it. He is very slow to use his armory of ready-made concepts and logical processes. He knows that the old weapons will probably need much refurbishing before they can be effective in the new cycle. In the end his previous scientific experience plays its brilliant rôle, all the more brilliant because of its forced repression. The great error of science and philosophy has been to take the elements worked out by

analysis as absolute. This has been encouraged by the philosophy of universals and of conceptualism. Abstract numbers and abstract terms have received an adscription of a degree of independence unjustified by the methodology of an effective science. Wholes are all the time active in producing through their evolution material for their own enrichment and the enrichment of other wholes, viz., secondary qualities. Looking at the economic aspect of the evolution of wholes there is the process too, not only of efficient production, but also of its consumption, and also the problem of its marketing, and the problems of the correlating of these activities through government and law. The economic process is one in which wholes produce an abundance of secondary quality. But this analysis of the economic whole is strictly relative to its present stage of evolution. Sometimes marketing and distribution of secondary quality and sometimes the legal and sovereign activities, and again the productive processes of efficiency dominate. The relevancy of any science depends on its sensitive adaptability to particular evolutionary stages of its wholes. When the elements of scientific analysis are taken as absolute and not as relative to the atomic whole in its particular stage of evolution, the science becomes tangential to the cyclic movement of evolution and acquires an irrelevance to actual situations.

Now the speculative question may be raised; are secondary qualities derived from something more primitive and also qualitative? We observed that measurements did something to the qualities they measure and we also noted that measured qualities are very imperfectly analyzed into measurements and qualities. The two are separated only by a process of abstraction. And even the process of abstracting measurements from the qualities they measure is of doubtful validity if the analysis *in situ* is carried beyond the very superficial. Let us take the whole system of pointer readings, measurements, and try to subtract them from reality. We are quite certain that this system of Pythagorean number is not quite the stuff of which everything is made. There must be something left when we subtract it from the totality, the wholeness of all things, if subtraction is at all possible. In making this subtraction we must bear in mind that we must include space in our measurements. Space, Descartes' and Galileo's extension, must come out from things if they can and we must then see what is left. That which is left must be something unextended and unspatialized. As the space which we have subtracted is the space of relativity, the space-time continuum, the residue left is something much like Bergson's unspatialized time, duration, or Newton's "absolute true and mathematical time." Only Newton conceived of it as having some meas-

urement left in it, for he described it as flowing "equably." This is reasonable on Newton's part, for the residue is actually inconceivable unless some measurement is left in it. For Bergson's duration is inconceivable and yet it is what is left after the attempted subtraction. To give it a plausible but pseudo conceivability he has to give intuition a new meaning as an impossible substitute for intelligence, designed for the very purpose of apprehending a duration stripped of anything that can be called a measurement of it. Whatever this impossible duration of Bergson's may be it is the stuff of which the world is made before measurement has ever touched it, if the world were ever in such a condition. This inconceivable substance of all things has come from just that attempt to abstract measurements from what they measure. The inconceivability is good evidence for the proposition that measurement can not be even abstracted from what it measures, say nothing about separating the two in any concrete sense. We find then a more intimate union of the measured and the measurements. Thus if we go back in the process of evolution to this more primitive quality, duration, we find that it is strikingly inseparable and ever inconceivable apart from its measurement.

Thus we may be permitted to add to the better-grounded argument given above this speculative possibility pointing to the resolution of the dualism of Eddington of a metrical and a non-metrical, into a monism whose unit is a measured quality where even the grammatical and logical analysis into substantive and adjective breaks down more completely than before.

If there is thus a primitive measured quality time, duration, already measured in the most primitive form of it, it must get additional measurements through the cyclic process of its evolution, coming to be measured into those periodicities that make color and sound of it.

This speculative excursion is not needed for the argument of this paper, but it is suggested by the main discussion and it points to the intimate union of the measured and the measurements that measure it, of the qualitative and the quantitative, of the so-called mental and the so-called material.

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THE THEORY OF RELATIVITY: FOR WHAT IS IT A DISGUISE?[1]

IT is generally assumed that Einstein, in propounding the theory of relativity, has discovered something hitherto unsuspected about time and space, namely, that they are functions of the rela-

[1] Read at the meeting of the American Philosophical Association, New York, December, 1929.

tive motion of material bodies, and hence share the property of relativity which motion itself possesses. But if we examine this assumption in the light of Einstein's writings we find it to be a mistaken one, since the kind of time and space referred to by Einstein are by him *defined* to have this property, not *discovered* to have it. In short, the "discovery" is expressible in the proposition "Relative time and space are relative," a truism embodying as much discovery as the proposition that right-angled triangles are right-angled. Both of these propositions are true, but neither can be the expression of a theory, certainly not of a debatable one.

The fact is that Einstein has appealed to no new physical cause in his successful prediction of physical phenomena. He has simply substituted new definitions of "time" and "length" for the Newtonian ones. And how a mere change in the definitions of words, a mere juggling of units of measurement, can afford predicting power, is the mystery which besets modern physics and nonpluses modern physicists. As Bridgman expresses it: "Three definite conclusions about the physical universe have been taken out of the hat by the conjuror Einstein, . . . and the problem for us as physicists is to discover by what process these results were obtained."[2]

In this paper I shall venture to advance an hypothesis of the nature of this seemingly magical process, and shall therefore at the outset direct attention to the expedient by which Einstein obtained his new definitions. The history of physics tells us what it was.

A certain experiment designed to discover the earth's motion relative to the ether, involving the observation of interference fringes in light, had been proposed. A certain formula expressing the shift of these fringes to be expected assuming a given velocity (v) of the earth, had been worked out. A certain interferometer sensitive enough to reveal the shift assuming (v) to be at least as high as the known velocity of the earth in its orbit, had been devised. The experiment was tried by Michelson and Morley and came out negative. The expected shift was not observed. And physics was thus confronted with the question, "Why?"

Einstein undertook to answer this question, and in order to do so, he first examined the formula predicting the shift, which contained, among others, the fundamental magnitudes, or "dimensions," time and length. He then asked himself this question: "By what change in the definitions of time and length can I make this formula come out negative for all velocities of the earth and other bodies?" And proceeding to make the necessary calculations, he

[2] *The Logic of Modern Physics*, P. W. Bridgman, p. 171.

formulated the so-called "Lorentz transformation"[3] expressing his new definitions of time and length (interval). This transformation embodies the special theory of relativity, and the general theory is a modification of the special.

Now the process used by Einstein is a special case of a very general one, which may be called the process of discovering "dimensional explanations," so called because it consists in redefining one or more of the fundamental dimensions, time, length, and mass, of which other physical magnitudes, such as velocity, acceleration, etc., are functions. It may be briefly described as a process for transferring to one or more of these dimensions, the variability of physical causes in such a manner that the variability of the cause is expressed in the formula by a variability (relativity) of the appropriate unit or units, and hence can be attributed to that relativity. Instead of leaving the units constant and correcting for the varying cause, the cause is assumed constant, and the correction made by varying the units,—both processes giving the same result. Given the requisite mathematical ability, as many kinds of relative time, length, mass, space, velocity, etc., as we please may be "discovered," and they will all have the magical predicting power which the kinds devised by Einstein are found to have.

For instance, it is possible to retain the assumption prevailing previous to Römer that the velocity of light is infinite, and predict all effects on light signals actually due to the finite velocity of light by redefining time according to the following "transformation":

$$T' = T + \frac{d}{186{,}000} \tag{1}$$

where T' is the time in seconds on the observed system, T the time on the observing system, and d the distance in miles between the systems, thus discovering a relativity of time with distance. And it is also possible to adopt the assumption that the earth is a perfect rotationless sphere, and predict all effects on the rate of pendulum swing at different latitudes actually due to the rotation and oblateness of the earth, by redefining time according to the following "transformation":

$$T_l = T_0 \frac{1}{\sqrt{1 - .0025 \cos 2L}} \tag{2}$$

where T_0 is the time at latitude 45°, L, the latitude, and T_l the time at latitude L; thus discovering a relativity of time with latitude.

Indeed, a dimensional explanation is characterized by the fact that it is not an alternative to, but a disguise for, a non-dimensional one; a non-dimensional explanation being one which retains the

[3] Lorentz had previously arrived at this transformation on the basis of Maxwell's equations and the assumption of a stationary ether.

Newtonian definitions of dimensions, and attributes effects to physical causes instead of units of measurement. Thus the predicting power of a dimensional explanation is due exclusively to the fact that it constitutes a disguise for a non-dimensional explanation. And this brings us back to the hypothesis I am venturing to advance in this paper, which is that the equations of relativity possess predicting power because they embody definitions which are disguises for a non-dimensional explanation of some kind. In short, I shall assume that if some actual cause in nature corresponding non-dimensionally to his new definitions did not exist, Einstein's equations would have no predicting or explaining power. Our problem then can be formulated thus: Given the dimensional explanation provided by Einstein: *To find* the corresponding non-dimensional explanation.

This is a problem to which a possible solution will here be suggested. In order to render it generally intelligible, I shall first define a term necessary to its expression:

The phenomenon, common to sound and light waves alike, known as a Doppler-effect, is familiar to physicists. It is an effect on the waves caused by the movement of their source, a shortening of wave-length in the direction of motion and a lengthening in the opposite direction. It is the Doppler-effect which causes the pitch of a locomotive-bell to fall as it passes a person standing on the station platform, and it is the same effect that enables astronomers to measure the relative velocity in the line of sight of the earth and the stars. This effect is registered in the spectroscope as a displacement of spectral lines, a displacement toward the violet end of the spectrum when the star is approaching and toward the red end when it is receding. Now this change of wave-length is always associated with changes of momentum and energy in the radiation subject to it, changes inversely proportional to the square of the wave-length. To these associated effects may be given the name of Doppler-displacements.

Let us next consider the theory of space assumed by the Newtonians and Einsteinians, for despite Einstein's redefinition of "space," the two schools agree about space in one important particular. They agree that it is a static space, except for the starlight which traverses it. Indeed, this is the general assumption among physicists. The Newtonians, however, usually assume that space is filled with a static ether or medium which conveys the light, whereas the Einsteinians usually assume there is no ether at all.

The theory which I shall venture to propose resembles the Newtonian more than the Einsteinian assumption. It assumes that there is an ether, but that it is a dynamic instead of a static one. The

basic assumption of the theory is that space is filled with radiation of super-frequency and hence super-penetration, moving in all directions, essentially as star-light does, and having the same velocity—186,000 miles a second; and that matter (as well as light) is a modification of this field of radiation which transforms a minute fraction thereof into a form less absorbed by matter than the normal. It is further assumed that all material change of motion is due to unbalanced radiation pressure in this field or some modification of it, a rather plausible assumption, since it has been proved in the laboratory that radiation exerts pressure on bodies which absorb or reflect it.

The theory thus briefly and incompletely expressed, I shall call the radiation theory. And I shall assume that the relativity definitions of time and space are disguises for, and mathematical equivalents of, the Doppler-displacements in the radiation postulated by the radiation theory. In short, it is these Doppler-displacements which provide the non-dimensional counterpart of the Einsteinian dimensional explanations, and it is because they are causes actually operating in the universe that the relativity equations have predicting power.

Now it is obvious that in a brief paper such as this, it would be impossible to go into details about the predictions of the radiation theory, and the comparison thereof with facts. Suffice it to say that many predictions are forthcoming, relating to both relativity and non-relativity phenomena, and that their accordance with the facts is, on the whole, confirmatory of the theory. In the present condensation only a summary of the more suggestive verifications can be given, as follows:

(1) The radiation theory predicts that relativity effects will be a maximum in directions coinciding with, or opposite to, that of the motion of bodies, because Doppler-displacements are.

According to the Lorentz transformation, the effects are a maximum in these two directions.

(2) The radiation theory predicts that relativity effects will be zero in directions transverse to the direction of motion of bodies, because Doppler-displacements are.

According to the Lorentz transformation the effects are zero in transverse directions.

(3) The radiation theory predicts that relativity effects will diminish from a maximum in directions coinciding with or opposite to the direction of motion of bodies to zero in directions transverse thereto in accordance with the cosine law, because Doppler-displacements do.

According to the Lorentz transformation, the effects thus diminish in accordance with the cosine law.

(4) The radiation theory predicts that relativity effects will approach zero as the velocity of bodies approaches zero, because Doppler-displacements do.

According to the Lorentz transformation, relativity effects approach zero as the velocity of bodies approaches zero.

(5) The radiation theory predicts that relativity effects will approach infinity as the velocity of bodies approaches that of radiation, because Doppler-displacements do.

According to the Lorentz transformation, relativity effects approach infinity as the velocity of bodies approaches that of radiation (light).

(6) The radiation theory predicts that relativity effects will be functions of c/n instead of c alone, when the index of refraction of the medium through which the body is moving is n, because Doppler-displacements are.

According to the fully expressed Lorentz transformation, relativity effects are functions of c/n instead of c alone, when the index of refraction of the medium through which the body is moving is n.

(7) The radiation theory predicts that the relativity theory will be divided into two parts, according as the motion of the bodies subject to relativity effects is uniform or accelerated, because the Doppler-displacements in the two cases follow different laws.

According to the relativity equations, the relativity theory divides into two parts, the first, or special theory applying exclusively to uniform motion, and the second, or general theory applying exclusively to accelerated motion, this division being required because it is found that, to conform to the facts, the equations in the two cases must follow different laws.

(8) The radiation theory predicts that of the two parts into which the relativity theory will be divided, the one applying to uniform motion will be a limiting case of the one applying to accelerated motion, because the Doppler-displacements due to uniform motion are limiting cases of those due to accelerated motion.

In accordance with this prediction, the equations of the special theory of relativity are limiting cases of those of the general theory.

(9) The radiation theory predicts a variation of gravitation with distance conforming to the inverse square law, because the unbalanced radiation pressure, which it assigns as the cause of gravitation, follows that law.

According to Newton, and all physicists following him, the variation of gravitation with distance conforms to the inverse square law.

(10) The radiation theory predicts a propagation of gravitation with the velocity of light, because the radiation whose pressure it assigns as the cause of gravitation is propagated with that velocity.

According to many eminent modern physicists, including Einstein and Eddington, gravitation is propagated with the velocity of light.

(11) The radiation theory predicts dependence of potential energy upon motion, because of its dependence upon the transmutation of kinetic energy in bodies into energy of ethereal radiation.

According to Tait (other physicists agreeing), "We are . . . forced to the conclusion that potential energy . . . depends (in some as yet unexplained, or rather unimagined way) upon motion."[4]

(12) The radiation theory predicts proportionality between the inertia and gravitation of bodies, irrespective of their size, because the energy exchange to which that theory attributes inertia, and the exchange to which it attributes gravitation, are exchanges with the same material units which constitute bodies.

According to the facts, as first demonstrated by Galileo at Pisa, such proportionality between the inertia and gravitation of bodies, irrespective of size, is observable.

(13) The radiation theory predicts deviations from the inverse square law of gravitation when the gravitating bodies are in relative motion, because of the Doppler-displacements accompanying such motion.

According to the general theory of relativity, and generally accepted inferences from the observed rate of rotation of the perihelion of the planet Mercury, deviations of the order of magnitude predicted, occur.

(14) The radiation theory predicts an increase of mass with motion, according to the well-known equation

$$M_v = M_o \frac{1}{\sqrt{1 - \frac{V^2}{C^2}}}$$

because, as shown by Larmor,[5] this equation is of the form which expresses the increase of radiation with velocity (V) of its source.

According to the theories, both of Lorentz and of Einstein, and the facts of the Kaufmann-Bucherer experiment, an increase of mass with motion according to the equation

$$M_v = M_o \frac{1}{\sqrt{1 - \frac{V^2}{C^2}}}$$

occurs.

(15) The radiation theory predicts that the variation of the

[4] *Encyclopedia Brittannica*, 9th edition, Vol. XV, p. 748.

[5] *Collected Scientific Papers of J. H. Poynting*, p. 755.

mass and diameter of bodies with motion, if any variation of diameter occurs, shall be concomitant, because due to a common cause, namely, motion relative to a radiant ether.

According to the theories both of Lorentz and of Einstein, based on the Michelson-Morley and Kaufmann-Bucherer experiments, the variations of mass and diameter of bodies with motion are reciprocals of each other, and hence quantitatively concomitant.

(16) The radiation theory predicts that the Doppler-effect in light (but not in sound) will be interpreted by the relativists as an effect depending upon the relativity of time and length, because this effect is a Doppler-displacement.

According to the relativist interpretation, the Doppler-effect in light (but not in sound) is an effect depending upon the relativity of time and length.

(17) The radiation theory predicts that the effects on light by moving matter discovered by Fizeau and Airy, respectively, will be interpreted by the relativists as effects depending upon the relativity of time and length, because, at the velocities involved in the Fizeau and Airy experiments, neither are distinguishable from Doppler-displacements.

According to the relativist interpretation, the Fizeau and Airy effects are effects depending upon the relativity of time and length.

Here are seventeen verifications of the radiation theory, and if time permitted, I could add others to them. If that theory is untrue, they must be regarded as a mere combination of coincidences. Perhaps they are, but what are the chances that seventeen, or even seven, casual coincidences would thus conspire to simulate causal ones? Among these verifications, indeed, are three, any one of which appears to be an *experimentum crucis* in favor of the hypothesis that the relativity definitions disguise a radiation displacement. I refer to the three effects last mentioned. For in these particular cases, the radiation displaced is neither more nor less than that familiar to us as light, and hence no theorizing is required in order to discover what the relativity definitions are disguising. Moreover, to complete the evidence, Einstein himself not only admits, but insists, that there is no opposition between the relativity and non-relativity explanations of these effects. In short, both are true; and how can both be true unless one is a disguise for the other? In the Doppler, Fizeau, and Airy effects, then, we have veritable Rosetta Stones of Relativity, on which are inscribed the dimensional and non-dimensional explanations side by side, the first in the mysterious language of relativity, the second in the familiar language of radiation displacement—and the translation reveals what the radiation theory predicts.

This statement of the evidence for the radiation theory must suffice for the present paper. It is a very incomplete statement, but represents fairly the evidence as a whole. If the radiation theory is sound, however, it is plain that Einstein has discovered nothing about time, space, motion, or acceleration unknown to the Newtonians, or shown that what they have hitherto assumed about those magnitudes is contrary to any fact in nature. What, then, has he done that is important to physics and to science in general? I submit that the evidence herein presented appears to indicate that what he has done is simply this: He has, by means of very great mathematical genius, succeeded in hitting upon the dimensional disguise for the Doppler-displacements of a radiant ether, which are inevitable if human beings, contrary to what has been hitherto assumed, inhabit a dynamic, instead of a static, universe.

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BOOK REVIEWS

Coleridge on Logic and Learning; with selections from the unpublished manuscripts. ALICE D. SNYDER.

Professor Snyder's study of Coleridge's system of thought and theories of education is based almost entirely on unpublished manuscripts. It illustrates most forcibly the large amount of work Coleridge actually did accomplish in his later life, which is quite contrary to the popular belief that he planned and dreamed only. Students of his manuscripts in the past few years have just begun to investigate them and to realize the possibilities and importance they hold in creating a change of view regarding his industry or of his genuine efforts to carry out what he often discusses in his letters and conversations, though so little of it was ever given to the world during his lifetime; and that which was edited after his death suffered considerably by the scruples of his editors. With the exception of Henry Nelson Coleridge's editions of the marginalia and notes, dating from 1836 to 1839, and Ernest Hartley Coleridge's edition of the *Anima Poeta* and *Letters* in 1895, there has been not a single significant volume of prose issued which contains wholly new material, until the appearance of this book by Professor Snyder. Even the numerous studies of Coleridge's *sources* only too frequently fail to include fresh matter, with, of course, the outstanding exception of Professor Lowe's *The Road to Xanadu*. As a matter of fact, serious research in Coleridgeiana is only of recent date.

The Coleridge student has had to content himself with meagre

notes from diaries or notebooks, and marginalia from books, when he attempted to piece together any of Coleridge's grand projects; but to the merely casual student of his works it is source of irritation to find unavailable a connected view of any one of them. The existing editions of Coleridge are a hodge-podge of unrelated matter, with little or no attempt by the various editors to present what continuity may exist. The little that has been recovered from his numerous existing note-books and marginalia suggest only in a limited way the amount still buried in manuscript of all sorts. He often thought of collecting the mass himself, but he continued to add to it as fancy prompted, or as he says: "What I have seen and what I have thought, with a little of what I have felt, in the world in which I told and talked them to my pocket-books, the confidants who have *not* betrayed me, the friends whose silence was not distraction, and the inmates before whom I was not ashamed to complain, to yearn, to weep, or even to pray!" Anyone who is fortunate enough to see an unpublished note-book of his will find interest enough in its personal allusions, literary criticism, bits of poetical fancy, and always records of schemes rarely developed beyond their first stages.

The purpose of Professor Snyder's book is obviously not just to convince the reader that Coleridge was far from being the "affectionate visionary." For the first time in the editing of his notes or fragments there is meaning and significance attached to them, which is quite in contrast to the jumbled lot as it exists in all ordinary editions. Indifferent editing has probably seriously affected a wider understanding of Coleridge than he has had, but in Professor Snyder's book the student will have little cause to be confused, as the importance of Coleridge as a logician, scientist, metaphysician, encyclopedist, and educator receive the results of her long work, in compact and closely written form.

It is a commonplace to state that the spirit and effect of Coleridge's teachings live largely through the men who came under his spell during his lifetime. Few men have equalled him in inspiring thought and in creative production. That supremely intellectual activity was in the main directed to lead those who listened to him, and for that reason he is inseparably associated with the idea of a teacher. In a limited sense most of his prose is fundamentally didactic, and particularly that attitude often dominates in his epistolary writings. Naturally, his conversations illustrate this more than any other record. This zeal for instruction was invariably in conjunction with his theories of the method and the technique of thinking, which generally superseded or altogether displaced the very thing that may have come up for his

consideration. His exploration in mental imagery is one of the most conspicuous examples of his endeavor to put thought processes on a more critical basis; and it was in this very dissatisfaction of accepted modes of conveying ideas that constantly thwarted and prevented him from expressing his conceptions clearly. He sought endlessly for the *media* that might bring out what may have been fairly real to him; but he felt too often the inadequacy of words as commonly perceived, and hence his refusal to proceed with explanations unless the terms used were put in their true lights and shades. Every approach to a field of knowledge was subject to an elaborate analysis, time or effort for its accomplishment mattered little to him, for the possibilities of its investigation led him on interminably. The proposal for any work was always most comprehensive, as is evidenced by all of his published projects; but Professor Snyder has printed in her book a hitherto unpublished plan surpassing in breadth and design any known one. In fact, it presents Coleridge's reflections on writing an epic as well as containing a synopsis of his *Opus Maximum*. As a confirmation of his frequent allusions in his writings that he was evolving such works, it is an extremely valuable document, though its chief interest lies in its display of the range of his mind and its refusal to function except in the most myriad-like manner. He was always obsessed with ideas for writing a great philosophical epic, and in this synopsis there is some tangible evidence of what he pondered upon. Its scope is so wide that only its more conspicuous features can be mentioned here. Part I was to commence with the "Absolute Actuality, Essentially Causative of all Reality," which included the "Eternal Possibilities," and the "Will to Actualize the Eternal Possibility," but to end with the inevitable "Consequence—or the Apostasy." The second part conceived the "Birth of Time and Nature" on an evolutionary basis, which magnificently displays Coleridge's knowledge of science. The remaining three highly detailed parts carry his oft-repeated Divine Logos into biblical history. Theories transcend poetic concepts, and the whole outline is more of a foundation for a dissertation on cosmology and theology than a design for an epic.

Over one-half of Professor Snyder's book is taken up with Coleridge's logic, which for many years has been the primary interest in her researches. Doubtless her disposition of the much neglected two-volume manuscript of his *Logic* in the British Museum (Egerton 2825, 2826) will be regarded as final for some time to come. That J. H. Green showed "sound discretion" in not publishing it she fully believes, since in its turgid and incoherent state there is little of it that would add to what is already recog-

nized as his contributions to logic. Moreover, it has been badly transcribed by two amanuenses. She believes that since it is in such a chaotic form, there is sufficient material in the published works, with additions from the unpublished, to reconstruct the main thesis of this manuscript treatise. Professor Snyder's verdict that it should remain unprinted in the British Museum, "where it can be referred to by the occasional specialist," will not likely be accepted by the scholar who has not examined it; but for the one who is interested in general, she has selected for publication only "certain interesting and relatively printable passages, and some material that may conceivably throw light on the problem of Coleridge's sources." One most salient feature about the manuscript is that Kantian thinking is so merged with Coleridge's own involved or fairly unintelligible ideas that its editing presents an almost insuperable task. The first volume of the *Logic* receives only a short summary of its main purport, and from it there are a few small quotations printed. The second volume receives, however, considerably more analysis of its contents. Wherever Coleridge has employed Kant or Mendelssohn, the essential differences are carefully considered, and particularly does Professor Snyder emphasize the difficulties of publishing the entire work when she indicates that passages are taken *verbatim* from these two sources. There is frequent mention that "here Coleridge follows Kant, and such amplifications as he indulges in add nothing of importance"; and "the chapter called 'Judicial Logic, including the Pure Aesthetic' (pp. 212–245), is essentially an epitome of Kant's transcendental aesthetic as it is developed in the *Critique of Pure Reason* and the *Prolegomena"*; or the "Three short chapters on analytic and synthetic judgments (pp. 265–281), do little but restate Kant," as he drew from the same source as the preceding.

Coleridge as an "Encyclopedist" and an "Educator" is treated tersely and compactly. The originality of his idea to incorporate into one monumental work all knowledge interpreted philosophically is made exceptionally important in the light of the history of encyclopedias. His *Treatise on Method* in education shaped some entirely new conceptions about academic study, obviating as it did the stultifying factual learning process. That Coleridge has left the impress of his system of education and instruction in modern practice is only vaguely appreciated, but Professor Snyder believes, in common with Miss Marjorie Nicolson in her study, "James Marsh and the New England Transcendentalists," [1] that there is possibly some fairly definite relationship between Coleridge's principles of education and the ones similarly incorporated

[1] *Philosophical Review*, Vol. 34, pp. 28–50.

in the American college as imposed by Professor Marsh, one of this country's earliest disciples of Coleridge. Equally significant, too, is J. H. Green's educational addresses delivered before the Royal College of Surgeons in 1831 and 1832, and also in 1841 and 1847, where he expounded Coleridge's theories of a liberal education for the foundation of science, or the inter-relationship between science and philosophy. As Professor Snyder observes, there is no definite evidence of how much influence these lectures had, but the mere fact that he was president of the College twice and Hunterian orator of it twice also indicates the impression he must have made. Whatever tangible connection may exist between Coleridge's educational theories and the actual practices of educators who may have been inspired by them, Professor Snyder largely conjectures, though she leaves little doubt in regard to the possibilities of research in that field.

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JOURNALS AND NEW BOOKS

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NOTES AND NEWS

By a gift of the late Edgar Pierce, Ph.D., Harvard, 1895, and author of *The Philosophy of Character,* a Lectureship in honor of William James has been established in Harvard University. Dr.

Pierce was at one time Instructor in Psychology at Harvard, and later was a member of the Visiting Committee for the Department of Philosophy and Psychology.

Appointments will be made to this Lectureship at least biennially, the appointees being in residence at the University and participating in the regular instruction. Professor John Dewey will be the first lecturer on this foundation. During the spring term beginning February, 1931, he will deliver a series of ten public addresses on a topic not yet announced. The subjects covered in the William James Lectures are not limited in any way, beyond the general condition that they must fall within the field of philosophy and psychology. The lectures will appear in book form.

The publisher, G. Barbèra of Florence, Italy, announces a forthcoming reprint of the complete works of Galileo Galilei. It is based on the great "National Edition" prepared by Antonio Favaro during the years 1888–1909, but contains such additions and corrections as have been found necessary. The edition will consist of twenty-one volumes, to be published three a year. It is limited to five hundred numbered copies and the price is 4500 lire for the set. Subscribers will be required to remit 225 lire per volume in advance, on receipt of a notice from the publishers. The twenty-first volume will be delivered gratis.

Volumes I–IX, inclusive, contain Galileo's scientific philosophical works; Volumes X–XVIII, inclusive, contain the Galilean correspondence from 1574–1642, arranged in chronological order and with a chronological index; Volume XIX contains all the documents relating to the life of Galileo from the marriage contract of his parents to the record of his death, and the inedited biographies by his contemporaries. A notable part of the volume deals with the documents relating to Galileo's trial; Volumes XX and XXI contain supplementary material and the indexes to the previous volumes, an index to the facsimiles, names, and notable events, as well as an exhaustive index of Galileo's contemporaries.

This monumental and beautiful edition of Galileo will be welcomed by students of the history of science and philosophy. It makes available much valuable source material relating not merely to Galileo, but to the origins of modern scientific thought in general.